Claims:

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1. A method comprising the steps of:

a) optically sensing vibration from a structure; and

b) determining whether a fault exists in the structure, based on the vibration optically-sensed in the step (a).

2. A method as claimed in claim 1 wherein the step (a) comprises substeps of:

a1) generating and transmitting a laser beam to the structure;

a2) receiving the laser beam from the structure;

a3) detecting Doppler shift in the received laser beam relative to the transmitted laser beam; and

a4) determining at least one of the peak displacement and velocity of the vibration, based on the detecting of the substep (a3).

3. A method as claimed in claim 1 wherein the sensing of the step (a) is performed by sensing peak displacement of the vibration from at least one portion of the structure.

4. A method as claimed in claim 1 wherein the sensing of the step (a) is performed by sensing peak velocity of the vibration from at least one portion of the structure.

5. A method as claimed in claim 1 wherein the sensing of the step (a) comprises optically sensing vibrations from different portions of the structure corresponding to similar elements of the structure, the method further comprising:

c) comparing the vibrations from the different portions of the structure; and

the determining of step (b) performed based on the result of the comparing of the step (c).

6. A method as claimed in claim 5 wherein the comparing of the substep (b1) is performed based on peak displacement of the vibrations.

7. A method as claimed in claim 5 wherein the comparing of the substep (b1) is performed based on peak velocity of the vibrations.

8. A method as claimed in claim 1 wherein the step (a) is performed with a laser vibrometer.

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9. A method as claimed in claim 1 wherein the step (a) is performed with a Doppler laser vibrometer.

10. A method as claimed in claim 1 wherein step (b) is performed with a computer.

11. A method as claimed in claim 1 further comprising the step of:

c) vibrating the structure to produce the vibration sensed in the step (a).

12. A method as claimed in claim 11 wherein the step (c) comprises vibrating the ground in proximity to the structure to cause the structure to vibrate.

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13. A method as claimed in claim 11 wherein the step (c) comprises driving a vehicle over spaced objects to vibrate the structure.

14. A method as claimed in claim 11 wherein the step (c) comprises vibrating the ground with an ground vibrator.

15. A method as claimed in claim 11 wherein the step (c) comprises vibrating the ground by generating an explosion.

16. A method as claimed in claim 11 wherein the step (c) is performed by generating sonic waves.

17. A method as claimed in claim 16 wherein the sonic waves are generated with a speaker.

18. A method as claimed in claim 16 wherein the sonic waves are generated by noise from a helicopter.

19. A method as claimed in claim 11 wherein the structure is vibrated by direct application of force to the structure.

20. A method as claimed in claim 19 wherein the direct application of force is produced by bumping the structure with a vehicle.

21. A method as claimed in claim 11 wherein the step (c) is performed by exposing the structure to wind loading.

22. A method as claimed in claim 1 wherein the structure is a building.

23. A method as claimed in claim 1 wherein the structure is a house.

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24. A method as claimed in claim 1 wherein the performance of the step (b) determines that the fault exists in the structure, the fault being damage of a structure element.

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25. A method as claimed in claim 24 wherein the structure element comprises at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

26. A method as claimed in claim 1 wherein the performance of the step (b) determines that the fault exists in the structure, the fault being deterioration of a structure element.

27. A method as claimed in claim 26 wherein the structure element comprises at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

28. A method as claimed in claim 1 wherein the performance of the step (b) determines that the fault exists in the structure, the fault being a dislocation or separation between structure elements normally joined.

29. A method as claimed in claim 28 wherein the structure elements each comprise at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

30. A method as claimed in claim 1 wherein the performance of the step (c) determines that the fault exists in the structure, the fault being an improper joining of structure elements.

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31. A method as claimed in claim 30 wherein the structure elements each comprise at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

32. A method comprising the steps of:

a) optically sensing vibrations at spaced portions of a structure to produce a first set of vibration data readings;

b) establishing base line data from the first set of vibration data readings for respective spaced portions of the structure;

c) at a time after completion of performance of the sensing of the step (a), optically sensing vibrations at the spaced portions of the structure to produce a second set of vibration data readings;

d) comparing the vibration data readings of the second set with corresponding vibration data readings of the first set constituting the base line data to generate comparison result data; and

e) determining whether a fault exists in the structure at the time of performance of step (c), based on the comparison result data of the step (d).

33. A method as claimed in claim 32 wherein the step (a) comprises substeps of:

a1) generating a laser beam and transmitting the laser beam to the structure;

a2) receiving the laser beam from the structure, the received laser beam shifted in phase relative to the transmitted laser beam due to vibration of the structure;

a3) detecting the phase shift in the received laser beam; and

a4) determining at least one of the peak displacement and velocity of the vibration, based on the detecting of the substep (a3).

34. A method as claimed in claim 32 wherein the step (c) comprises substeps of:

c1) generating a laser beam and transmitting the laser beam to the structure;

c2) receiving the laser beam from the structure, the received laser beam shifted in phase relative to the transmitted laser beam due to vibration of the structure;

c3) detecting the phase shift in the received laser beam; and

c4) determining at least one of the peak displacement and velocity of the vibration, based on the detecting of the substep (c3).

35. A method as claimed in claim 32 wherein the comparing of the step (d) comprises comparing vibration data sensed in the steps (a) and (c) from different portions of the structure corresponding to similar elements of the structure.

36. A method as claimed in claim 32 wherein the comparing of the substep (b) is performed based on peak displacement of the vibrations.

37. A method as claimed in claim 32 wherein the comparing of the substep (b) is performed based on peak velocity of the vibrations.

38. A method as claimed in claim 32 wherein the step (a) is performed with a laser vibrometer.

39. A method as claimed in claim 32 wherein the step (a) is performed with a Doppler laser vibrometer.

40. A method as claimed in claim 32 wherein step (b) is performed with a computer.

41. A method as claimed in claim 32 wherein step (d) is performed with a computer.

42. A method as claimed in claim 32 wherein step (e) is performed with a computer.

43. A method as claimed in claim 32 further comprising the step of:

f) vibrating the structure to produce the vibration sensed in at least one of the steps (a) and (c).

44. A method as claimed in claim 43 wherein the step (f) comprises vibrating ground in proximity to the structure to cause the structure to vibrate.

45. A method as claimed in claim 43 wherein the step (f) comprises driving a vehicle over spaced objects to vibrate the structure.

46. A method as claimed in claim 43 wherein the step (f) comprises vibrating the ground with a ground vibrator.

47. A method as claimed in claim 43 wherein the step (f) comprises vibrating the ground by generating an explosion.

48. A method as claimed in claim 43 wherein the step (f) is performed by generating sonic waves to cause the structure to vibrate.

49. A method as claimed in claim 48 wherein the sonic waves are generated with a speaker.

50. A method as claimed in claim 48 wherein the sonic waves are generated by noise from a helicopter.

51. A method as claimed in claim 43 wherein the structure is vibrated in the step (f) by direct application of force to the structure.

52. A method as claimed in claim 51 wherein the direct application of force is produced by bumping the structure with a vehicle.

53. A method as claimed in claim 43 wherein the step (f) is performed by exposing the structure to wind loading.

54. A method as claimed in claim 1 wherein the structure is a building.

55. A method as claimed in claim 1 wherein the structure is a house.

56. A method as claimed in claim 1 wherein the performance of the step (b) determines that the fault exists in the structure, the fault being damage of a structure element.

57. A method as claimed in claim 56 wherein the structure element comprises at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

58. A method as claimed in claim 1 wherein the performance of the step (b) determines that the fault exists in the structure, and the fault is deterioration of a structure element.

59. A method as claimed in claim 56 wherein the structure element comprises at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

60. A method as claimed in claim 1 wherein the performance of the step (c) determines that the fault exists in the structure, and the fault is a dislocation or separation between structure elements normally joined.

61. A method as claimed in claim 60 wherein the structure elements each comprise at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

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62. A method as claimed in claim 1 wherein the performance of the step (c) determines that the fault exists in the structure, and the fault is an improper joining of structure elements.

63. A method as claimed in claim 62 wherein the structure elements each comprise at least one of a foundation, roof, ceiling, floor, wall, beam, column, support, joist, wall, wall panel, wall frame, window, window frame, duct, plumbing, piping, or hanger.

64. A system for detecting a fault in a structure, the system comprising:

an optical vibration sensor (OVS) positioned in proximity to the structure, the OVS optically sensing vibration of the structure, the OVS generating an OVS signal based on the sensed vibration from the structure, the OVS signal indicating whether the fault exists in the structure.

65. A system as claimed in claim 64 further comprising:

a computer coupled to receive the OVS signal, the computer generating a display based on the OVS signal, the display used by a human user to determine whether a fault exists in the structure.

66. A system as claimed in claim 64 further comprising:

a computer coupled to receive the OVS signal, the computer determining whether a fault exists in structure based on the OVS signal, the computer generating a computer signal indicating whether the fault exists in the structure.

67. A system as claimed in claim 64 wherein the computer generates the computer signal to indicate that a fault exists in the structure if the computer signal indicates that a peak displacement of the vibration at a portion of the structure, exceeds threshold amount data stored in the computer.

68. A system as claimed in claim 64 wherein the computer generates the computer signal to indicate that a fault exists in the structure if the computer determines that the OVS signal indicates that a peak velocity of the vibration at a portion of the structure, exceeds threshold amount data stored in the computer.

69. A system as claimed in claim 64 wherein the computer stores the OVS signal having vibration data for different portions of the structure, the computer determining whether a fault exists in the structure by comparing vibration data for similar structure elements to determine if there is a difference in the vibration data of similar structure elements, the computer determining that a fault exists in the structure if the difference between vibration data from similar structure elements exceeds threshold data stored in the computer.

70. A system as claimed in claim 64 wherein the OVS generates the OVS signal in a first performance of optical sensing to establish baseline data including vibration data readings at spaced portions over the structure, and generates the OVS signal at a second, subsequent performance of the optical sensing to generate after-acquired data including vibration data readings at spaced portions over the structure, the computer comparing the after-acquired data with corresponding baseline data, and determining a fault to exist in the structure if the difference between the after-acquired data and the baseline data exceeds threshold data stored in the computer.

71. A system as claimed in claim 64 further comprising:

an output device coupled to the computer, the output device generating a printed document, based on the computer signal.

72. A system as claimed in claim 64 wherein the computer comprises a drive unit for writing data indicating whether a fault exists in the structure onto a computer readable-medium, based on the computer signal.

73. A system as claimed in claim 64 wherein the computer is coupled to supply the computer signal indicating whether a fault exists in the structure to a remote computer via a network.

74. A system as claimed in claim 64 further comprising:

an OVS controller (OVSC) coupled to receive the signal from the OVS, the OVSC generating a vibration signal indicating vibration displacement of at least one portion of the structure, the OVSC coupled to supply the vibration signal indicating the vibration displacement to the computer as the OVS signal.

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75. A system as claimed in claim 65 further comprising:

an OVS controller (OVSC) coupled to receive the signal from the OVS, the OVSC generating a signal indicating vibration velocity of at least one portion of the structure, the OVSC coupled to supply the signal indicating the vibration velocity to the computer as the OVS signal.

76. A system as claimed in claim 65 wherein the OVSC is coupled to the OVS, and is operable to automatically focus the OVS on the structure.

77. A system as claimed in claim 65 further comprising:

a tripod coupled to the OVS, the tripod for positioning and supporting the OVS in relation to the structure.

78. A system as claimed in claim 65 further comprising:

a pan/tilt head coupled to the OVS, for aligning the OVS relative to the structure.

79. A system as claimed in claim 78 further comprising:

a position controller coupled to the pan/tilt head, the position controller controllable to generate a position signal supplied to the pan/tilt head to control alignment of the OVS relative to the structure.

80. A system as claimed in claim 79 further comprising:

a computer coupled to the position controller, the computer generating a position control signal supplied to the position controller, the position controller generating the position signal based on the position control signal.

81. A system as claimed in claim 64 wherein the OVS comprises a laser/sensor head.

82. A system as claimed in claim 81 wherein the OVS comprises an optical element coupled to the laser/sensor head.

83. A system as claimed in claim 82 wherein the optical element is a filter.

84. A system as claimed in claim 82 wherein the optical element is a lens.

85. A system as claimed in claim 81 wherein the OVS further comprises a scan unit for scanning a laser beam generated by the laser/sensor head over different portions of the structure, and for receiving the scanned laser beam from the different portions of the structure.

86. A system as claimed in claim 64 further comprising:

a vibration generator positioned in proximity to the structure, the vibration generator producing vibrations that travel to and vibrate the structure.

87. A system as claimed in claim 86 wherein the vibration generator comprises a vehicle and spaced objects, the vehicle driving over the spaced objects to vibrate the ground in proximity to the structure, to in turn vibrate the structure.

88. A system as claimed in claim 86 wherein the vibration generator comprises a ground vibrator that vibrates the ground in proximity to the structure, to in turn vibrate the structure.

89. A system as claimed in claim 86 wherein the vibration generator comprises a speaker generating sonic waves in proximity to the structure.

90. A system as claimed in claim 86 wherein the vibration generator comprises an explosive detonated in proximity to the structure to produce a shock wave to vibrate the structure.

91. A system as claimed in claim 86 wherein the vibration generator comprises a helicopter generating noise, the helicopter flown in proximity to the structure to vibrate the structure with the noise generated by the helicopter.

92. A system as claimed in claim 86 wherein the vibration generator applies direct force to the structure.

93. A system as claimed in claim 92 wherein the vibration generator is a vehicle driven to bump and vibrate the structure.